

# Rhodora

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## PLANTS NEW TO MISSOURI

JULIAN A. STEYERMARK

SINCE the publication in 1935 of "An Annotated Catalogue of the Flowering Plants of Missouri" by Palmer and Steyermark,<sup>1</sup> the junior author has made extended expeditions into remote and previously uncollected areas of the state. The main purpose of these explorations has been to gather additional records for completing ranges of species in the state in connection with the preparation by the two authors of a manual of the flora of Missouri and adjacent Ozark region. These trips have yielded valuable additions to the state flora, and in many cases have extended considerably the ranges of a number of species in the last edition of Gray's Manual.

Of the 38 new records given below, 24 are species entirely new to Missouri, of which 6 are species of *Carex* and 2 are species of *Eleocharis*; 7 are varieties, 3 are forms, 1 was previously reported but the report has never been authenticated by a specimen, and 3 are hybrids new to the state.

All collections made by the author as given in the citations below may be found in the Herbarium of the Missouri Botanical Garden. Most of the determinations of grasses were made or verified by Mrs. Agnes Chase, of *Carex* by Dr. F. J. Hermann, of *Eleocharis* by Dr. H. K. Svenson, of *Sisyrinchium* by Mr. E. J. Alexander, and of *Liparis* by Professor Oakes Ames.

**CHEILANTHES TOMENTOSA** Link. This fern was suspected of occurring in the state several times, but each time the matter was checked, it was found that the specimen had been misdetermined, and the

<sup>1</sup> Palmer, E. J. and J. A. Steyermark, in *Ann. Mo. Bot. Gard.* 22: 375-758. 1935.



conclusion had just about been drawn that the fern was not to be found in the state. During the summer of 1935 while collecting in the White River territory of southwestern Missouri in Stone Co., the author was exploring some steep limestone bluffs when suddenly he encountered several plants of this local fern. Careful study of the specimens revealed their identity, and the species can now be assigned to the state flora.

One-half way up exposed crevices of limestone bluffs on escarpment at mouth of Indian creek and White river, near Baxter, Stone Co., Aug. 22, 1935, *Steyermark* 19530.

BROMUS PURGANS L., f. LAEVIVAGINATUS Wiegand. Lower portion of wooded slopes along North Fork of White river, near Rainbow (Double) Spring, 4 mi. southeast of Dora, Ozark Co., May 16, 1936, *Steyermark* 10456.

FESTUCA RUBRA L. A few plants establishing themselves in low woods near cabin along Big Piney river near Hooker, Pulaski Co., May 9, 1936, *Steyermark* 10389.

FESTUCA RUBRA var. LANUGINOSA Mert. & Koch. This grass has just been introduced into the state in lawn grass seed, and numerous plants have established themselves around the University City Senior High School in University City, St. Louis Co., May 6, 1936, *Steyermark* 10339.

ELYMUS RIPARIUS Wiegand. This species was found to be quite common in several sections of the southeastern Ozarks and was collected from the 3 counties of Dent, Shannon, and Butler. Along banks of Current river, just south of Paint Rock bluff, Shannon Co., July 26, 1936, *Steyermark* 12292; around top of sw.-facing limestone bluffs at Paint Rock bluff, along Current river, 8 mi. south of Exchange, Shannon Co., July 26, 1936, *Steyermark* 12310; openings in thickets along beaver-dam on north prong (Hutchins Creek) of Meramec river, between Stone Hill and Indian Trail State Park, T 34 N, R 4 W, sect. 11, Dent Co., Aug. 4, 1936, *Steyermark* 12544; upper cherty slopes bordering Mud Creek, 2 mi. northwest of Rombauer, T 26 N, R 7 E, sect. 20, Butler Co., July 7, 1936, *Steyermark* 11360.

ARISTIDA LONGESPICA Poir. var. GENICULATA (Raf.) Fern. Sterile open woods, 4 mi. west of junction of highways no. 14 and no. 67, in Butler Co., Oct. 18, 1936, *Steyermark* 20468.

DIGITARIA ISCHAEMUM Schreb. var. MISSISSIPPIENSIS (Gattinger) Fern. Collected in Phelps County.

PANICUM CALLIPHYLLUM Ashe. This rare species, hitherto unknown west of Ohio, was collected on dry cherty slopes of an oak-southern yellow pine association in the southeastern section of the Ozarks. Upper cherty slopes along Current river, 2 mi. below mouth of Wells creek, T 23 N, R 2 E, sect. 8, 7 mi. northwest of Doniphan, Ripley Co., Oct. 19, 1936, *Steyermark* 20507.

PANICUM OLIGOSANTHES Schult. This species was omitted from the annotated catalogue of Missouri plants above referred to, because no

authentic specimen had been examined. However, Mrs. Chase has reported, in a letter to the writer, a specimen of this species from Greene County in the U. S. National Herbarium. This record is now substantiated by the author's discovery of this species from 3 additional southern Missouri counties. Top of sandstone bluffs along Mississippi river, 2 mi. north of Commerce, Scott Co., Nov. 7, 1936, *Steyermark 20749*; pine woods along fork of Little Piney river east of Piney Spring, Phelps Co., Nov. 28, 1936, *Steyermark 20901*; limestone slopes along North Fork of White river, near Rainbow (Double) Spring, 4 mi. southeast of Dora, Ozark Co., May 16, 1936, *Steyermark 10473*.

*Panicum villosissimum* Nash var. *pseudopubescens* (Nash) Fern. Cherty upland woods of ravine, tributary to Grand Glaize branch of Lake-of-the-Ozarks, 3 mi. southwest of Brumley, Miller Co., Oct. 25, 1936, *Steyermark 20685*.

*Eleocharis equisetoides* (Ell.) Torr. This adds another one of the southern species to the already large list of such to reach Missouri. The sink-hole pond in which it was growing in a large colony shares, with other similar ponds scattered over the dry uplands of southern Missouri, the distinction of harboring many rare and unique species of aquatic and marsh plants not found elsewhere in the state. Growing here with it were *Brasenia Schreberi* and *Nyssa aquatica*, the latter isolated here in the upland at its western limit in Missouri, and separated from its nearest swamp habitat in the southeastern lowlands to the east by a distance of almost one hundred miles. Tupelo Gum Pond, T 25 N, R 4 W, sect. 4, 9 mi. west of New Liberty, Fristoe Purchase Unit, Clark National Forest, July 24, 1936, *Steyermark 12266*.

*Eleocharis wolfii* Gray. This rare species of the central states was found by the author in the glaciated region of northern Missouri. Uncommon around swale in bottom prairie along East Yellow creek, 6 mi. east of Brookfield, Linn Co., June 5, 1936, *Steyermark 11028*.

*Scirpus subterminalis* Torr. The discovery of this northern species isolated in a wild remote spring-fed stream in southern Missouri adds another such relic to the flora. Other northern relics, similarly isolated in the Ozarks, are *Galium boreale* var. *hyssopifolium*, *Campanula rotundifolia*, *Zigadenus elegans*, *Menyanthes trifoliata*, and *Liparis Loeselii*. In still water of White's creek, Irish Wilderness, T 24 N, R 2 W, sect. 17, 4 mi. south of Wilderness, Oregon Co., Fristoe Purchase Unit, Clark National Forest, July 20, 1936, *Steyermark 12054*.

*Carex alata* Torr. This elegant species was common in various sink-hole ponds of Oregon and Howell Counties where its tall quadrangular culms and large tussocks shared company with the also tussock-forming *Carex decomposita* and *Carex comosa*. Forming tussocks in Brushy Pond, 2 mi. south of CCC Camp F-8, T 25 N, R 3 W, sect. 18, 3 mi. southwest of New Liberty, Oregon Co., Fristoe



Purchase Unit, Clark National Forest, July 24, 1936, *Steyermark 12263*; crotches of *Cephalanthus* bushes in swamp between Moody and Southfork, Howell Co., June 9, 1933, *Steyermark 9542*.

*CAREX SUBERECTA* (Olney) Britton. Marly swampy meadow along Bee Fork, 5 mi. east of Bunker, T 32 N, R 2 W, sect. 23, Reynolds Co., Clark Purchase Unit, Clark National Forest, Aug. 5, 1936, *Steyermark 12570*; limestone ledges along creek in Barn Hollow Canyon, 5 mi. southeast of Arroll, Texas Co., May 26, 1935, *Steyermark 19128*.

*CAREX MOLESTA* Mack. Prairie between Tipton and Fortuna, Moniteau Co., May 23, 1936, *Steyermark 10616*; grassy slopes bordering Osage river, at Duroc, Benton Co., May 24, 1936, *Steyermark 10721*.

*CAREX COMMUNIS* Bailey. This species was found in the White River territory of southwestern Missouri and is represented by the author's following collections: wooded limestone slopes below Table Rock along White River, Taney Co., April 25, 1936, *Steyermark 10116*; half way up wooded limestone slopes along White river, east of Smith Ford, south of Shell Knob, Barry Co., April 26, 1936, *Steyermark 10229*.

*CAREX GRACILESCENS* Steud. On north-facing wooded slopes of Crowleys Ridge between Benton and New Hamburg, Scott Co., May 2, 1936, *Steyermark 10299*.

*CAREX SUBTRICTA* (Kükenth.) Mack. Along wooded bank of Ten Mile creek, T 26 N, R 3 E, sect. 36, 4 miles southeast of Ellsinore, Carter Co., Wappapello Purchase Unit, Clark National Forest, July 13, 1936, *Steyermark 11735*.

*SISYRINCHIUM ATLANTICUM* Bicknell. This species grew in numerous dense clumps on a sandy prairie in the lowlands of southeastern Missouri. The decidedly glaucous leaves and stems, the latter conspicuously forking and bearing elongate peduncles, mark this species very well in the field. The discovery of this species in Missouri adds another one of the coastal plain-Mississippi Embayment species to the flora and marks the present northwestern limit of this species. Sandy prairie, 2 mi. west of Charleston, west of Charleston Cemetery, Mississippi Co., May 2, 1936, *Steyermark 10294*.

*LIPARIS LOESELII* (L.) L. C. Rich. This is the first authentic collection of this species from the state, other reports having been based upon erroneous records or misidentified material. The plant was found in wet thickets of an alder swamp (*Alnus rugosa*) with *Cirsium muticum*, *Aster puniceus* var. *lucidulus*, and *Pedicularis lanceolata*. This moist habitat appears quite characteristic for the species, whereas *Liparis liliifolia* is always found growing in Missouri in dry woods or on rocky slopes or ledges. In swampy alder thicket along Big creek, T 31 N, R 2 W, sect. 5, Shannon Co., Clark Purchase Unit, Clark National Forest, Sept. 26, 1936, *Steyermark 20123*.

*POPULUS TREMULA* L. Near Palmer, T 36 N, R 1 W, sect. 13, Aug. 18, 1936, *Steyermark 12997*. This species of the Old World has

established itself plentifully in this area in Washington county, Missouri.

*FAGUS GRANDIFOLIA* var. *CAROLINIANA* (Loud.) Fern. & Rehd. f. *MOLLIS* Fern. & Rehd. Along Castor river, north of Gipsy, Bollinger Co., July 12, 1936, *Steyermark* 11689.

*QUERCUS SCHUETTEI* Trelease (*Q. macrocarpa* × *bicolor*). Growing among the parent species in low alluvial woods along Monegaw creek near Monegaw Springs, St. Clair Co., Oct. 3, 1936, *Steyermark* 20216.

*BOEHMERIA CYLINDRICA* var. *DRUMMONDIANA* Wedd. (*B. cylindrica* var. *scabra* Porter). Wet meadow along Big creek, T 31 N, R 3 W, sect. 5, 2 mi. south of Melton, Shannon Co., Clark Purchase Unit, Clark National Forest, Aug. 7, 1936, *Steyermark* 12716.

*ARENARIA LATERIFLORA* L. Although this species has heretofore been reported for the state, this constitutes the first extant collection on record. Low woods along fork of Wyaconda river, between Arbela and Azen, Scotland Co., May 30, 1936, *Steyermark* 10808.

*DENTARIA LACINIATA* Muhl. var. *LATIFOLIA* Farwell. Low woods along White river, west of Table Rock, Taney Co., April 25, 1936, *Steyermark* 20138 and 20138a. This extreme of the species is well marked by its very large and broadly cut leaves.

*HEUCHERA PUBERULA* × *HEUCHERA AMERICANA* var. *HIRSUTICAULIS*. Plants which were referred to this status by Dr. Rosendahl and Dr. Butters were found in Wayne and Madison Counties within fifty miles of one another along the St. Francois river in southeastern Missouri. Hall's Bluff, along St. Francois river, 4 mi. south of Kime, T 27 N, R 6 E, sect. 5, Wayne Co., July 9, 1936, *Steyermark* 11542; crevices of limestone bluffs along St. Francois river, between mouth of Captain creek and bridge over highway to Jewett, Madison Co., Nov. 15, 1936, *Steyermark* 20980.

*OXALIS EUROPAEA* Jord. var. *BUSHII* (Small) Wieg. f. *VESTITA* Wieg. Rocky wooded slopes of Virgin Bluff, along James river, 2 mi. south of Cape Fair, Stone Co., May 9, 1936, *Steyermark* 10347.

*EUPHORBIA COROLLATA* var. *MOLLIS* Millsp. This hairy extreme of typical *Euphorbia corollata* is often encountered on limestone glades and barrens. Limestone glade on top of bluffs along Moreau river, 1½ mi. southeast of Jefferson City, Cole Co., Aug. 18, 1937, *Steyermark* 24902; limestone glade on bluffs of Gasconade river, 1½ mi. west of Jerome, Phelps Co., Aug. 26, 1937, *Steyermark* 25345; limestone glade along Niangua river, 5 mi. southwest of Long Lane, 2 mi. north of Hico, Dallas Co., Aug. 5, 1937, *Steyermark* 24249.

*THASPIUM TRIFOLIATUM* (L.) Gray. Plants of this species were collected during 1936 by Mr. George Moore in Laclede Co. All the vegetative and floral parts were purplish.

*HYDROCOTYLE VERTICILLATA* Thunb. For years species of this genus have been sought in vain in Missouri, and although reports of the genus were attributed to the state by several authors, no actual



specimens had ever been found. By happy chance while collecting along the North Fork of White river in Ozark County, southern Missouri, the author found this species locally abundant along springs seeping out along this stream about fifteen miles north of the Arkansas line. This is the first actual record of this genus from Missouri, and this statement is verified by Dr. Mildred Mathias Hassler, the present monographer of the genus. Along North Fork of White river, north of Rainbow (Double) Spring, 4 mi. southeast of Dora, Ozark Co., July 18, 1936, *Steyermark 11982*; same locality, May 16, 1936, *Steyermark 10400*.

*MENYANTHES TRIFOLIATA* L. var. *MINOR* Michx. The discovery of this species in a limey bog in Reynolds county in southeastern Missouri extends the range of this species considerably southwestward. The marshy meadow in which this was found was fed by a small spring whose seepage kept the area perpetually moist and harbored an abundance of *Rhynchospora capillacea*, *Carex suberecta*, *Galium tinctorium* (G. *Claytoni*), *Fuirena simplex*, and *Parnassia grandifolia*. Marly bog along north prong of Bee Fork, 5 mi. east of Bunker, T 32 N, R 2 W, sect. 23, Reynolds Co., Clark Purchase Unit, Clark National Forest, Aug. 5, 1936, *Steyermark 12564*.

*MIMULUS RINGENS* L.  $\times$  *MIMULUS ALATUS* Ait. Hybrids of these species were collected commonly in various parts of southeastern Missouri wherever both species occurred, as in Crawford, Ste. Genevieve, Shannon, and Reynolds Counties.

*SOLIDAGO RIDDELLII* Frank. This species, although reported for Missouri, was not included in the annotated catalogue of Missouri plants because no authentic specimens had been examined. There is a plant of this species in the Missouri Botanical Garden Herbarium which was doubtfully collected in St. Louis by Nicholas Riehl in the early part of the nineteenth century. During the autumn of 1936 the author found this species occurring in several swampy meadows in Dent and Shannon Counties in the southeastern Ozarks, and these constitute the first definite records for the state. Swampy meadow along Little Sinking creek, T 32 N, R 3 W, sect. 34, near Melton, in Dent Co., Sept. 26, 1936, *Steyermark 20129*.

*ASTER PUNICEUS* L. var. *LUCIDULUS* Gray. This aster was found growing plentifully in swampy meadows in Dent, Reynolds, Shannon, and Howell Counties in the southern Ozark region. It was associated with *Solidago Riddellii*, *Pedicularis lanceolata*, and *Solidago rugosa* var. *aspera*. The stems in this variety varied from more or less densely crisp-pubescent to glabrate. Wet meadow along Big creek, 2 mi. south of Melton, T 31 N, R 3 W, sect. 5, Shannon Co., Clark Purchase Unit, Clark National Forest, Aug. 7, 1936, *Steyermark 12689*.

*ASTER LAEVIS* L. var. *AMPLIFOLIUS* Porter. This broad-leaved extreme of the species was collected in Saline, Reynolds, and Cape Girardeau Counties. Wooded bluffs along Missouri river escarpment



at Miami, Saline Co., Oct. 11, 1936, *Steyermark* 20435; upper wooded top of limestone bluffs at east end of Hickory Ridge, 1 mi. west of Delta, Cape Girardeau Co., Nov. 8, 1936, *Steyermark* 20788.

FIELD MUSEUM OF NATURAL HISTORY,  
Chicago, Illinois

## THE OSCILLATORIACEAE OF SOUTHERN MASSACHUSETTS

FRANCIS DROUET

(Continued from page 241)

PHORMIDIUM Kütz. ex Gom., Ann. Sci. nat. VII Bot. 16: 156 (1892).—The diffuence of sheaths in this genus is a character often of too qualitative a nature for the beginner to recognize at first sight. It is evidenced macroscopically, however, in the tenacious character of the plant masses; whereas species of *Oscillatoria* form plant masses which are so fragile that they do not retain the original shape when lifted from the habitat, it is only rarely that the plant mass of a species of *Phormidium* breaks or loses form when lifted from its habitat. Microscopically the presence of amorphous jelly can be demonstrated easily by staining with dilute aqueous solutions of various dyes. A number of widely distributed species of this genus in North America are omitted here because of lack of specimens from southern Massachusetts. Among these are *P. purpurascens* (Kütz.) Gom., *P. laminosum* (Ag.) Gom., *P. Treleasei* Gom., *P. inundatum* Kütz. ex Gom., *P. Setchellianum* Gom., *P. favosum* (Bory) Gom., *P. subfuscum* (Ag.) Kütz. ex Gom., *P. uncinatum* (Ag.) Gom., and *P. penicillatum* Gom. *P. favosum* as distributed in Phyc. Bor.-Amer. 1652 is treated here as *P. autumnale*.

### KEY TO SPECIES

- I. Trichomes torulose, apices not calyptrate
  - A. Trichomes narrow (less than  $4\ \mu$  in diameter)
    1. Plant-mass growing within the sheaths of other algae or small animals.—Stratum small, pale or yellowish blue-green, in fresh water; filaments short (to  $50\ \mu$  long), straight, often parallel; sheaths usually entirely diffuent or thin and hyaline, not coloring blue when treated with chlor-zinc-iodine; trichomes pale blue-green,  $1.3\text{--}2\ \mu$  in diameter; cells as long as or twice as long as wide; protoplasm finely granulose; apical cell rotund above, rarely obtuse-conical. . . . . *P. mucicola*
    2. Plant-mass not within the sheaths of other algae or animals
      - a. Plants of salt or brackish water, rarely in fresh water; trichomes very small (less than  $2.5\ \mu$  in diameter)
        - (I) Stratum thin, rose-colored, in salt water; filaments loosely intertwined; sheaths thin or entirely diffuent into an amorphous mucus,

- not coloring blue when treated with chlor-zinc-iodine; trichomes pale rose-colored, attenuate at the apices,  $1.7-2\ \mu$  in diameter; cells  $2-7\ \mu$  long; rarely quadrate; protoplasm homogeneous; apical cell acute-conical. . . . . *P. persicinum*
- (II) Stratum mucous, lamellose, yellowish or brownish-green, in brackish or hot water; sheaths hyaline, diffuent into an apparently fibrous mucus, not coloring blue when treated with chlor-zinc-iodine; trichomes bright blue-green, variously interwoven or parallel, attenuated at the apices,  $1.2-2.3\ \mu$  in diameter; cells subquadrate,  $1.2-3\ \mu$  long; protoplasm not granulose; apical cell acute-conical. . . . . *P. fragile*
- b. Plants of fresh water; trichomes larger ( $2.5-4\ \mu$  in diameter).—Stratum thin-laminose, mucous, bright blue-green; sheaths diffuent into an amorphous mucus, not coloring blue when treated with chlor-zinc-iodine; trichomes bright blue-green, straight or almost so, parallel or variously intricate, not attenuate at the apices,  $2.7-3.3\ \mu$  in diameter; cells cylindrical or barrel-shaped, quadrate or twice as long as wide,  $3-7.8\ \mu$  long; protoplasm coarsely granulose; apical cell rotund. . . . . *P. molle*
- B. Trichomes broad (more than  $4\ \mu$  in diameter).—Plant-mass penicillate, attached by a basal stratum in fresh water, the free portion elongate, gelatinous, dark blue-green, yellowish-violet when dried; filaments more or less straight, parallel, closely agglutinated; sheaths often evident, mucous and usually entirely diffuent, not coloring blue when treated with chlor-zinc-iodine; trichomes pale blue-green (yellowish-violet when dried), straight and often long-attenuate at the apices,  $6-8.5\ \mu$  in diameter; cells quadrate or longer than wide (rarely to half as long as wide),  $3-11\ \mu$  long; protoplasm finely granulose; cross-walls never granulated; apical cell more or less acute-conical or cylindric-conical. . . . . *P. tinctorium*
- II. Trichomes not constricted at the cross-walls, at least not torulose except in certain species in which calyptras are present
- A. Trichomes not conspicuously calyptrate; apical cell never enlarged and capitate
1. Plant-mass violet, in fresh water; sheath material not coloring blue when treated with chlor-zinc-iodine.—Stratum membranaceous, lamellose, blue-violet or blackish-violet above, gray-green beneath; filaments straight, parallel or intermeshed; sheaths at first thin, scarcely evident, later entirely diffuent into an amorphous jelly; trichomes straight and not attenuate, fragile, very slightly constricted at the cross-walls,  $1.7-2\ \mu$  in diameter; cells subquadrate or longer than wide,  $1.8-4.7\ \mu$  long; protoplasm not granulose; cross-walls not granulated; apical cell rotund, without calyptra. . . . . *P. luridum*
2. Plant-mass not violet
- a. Trichomes narrow (usually less than  $4.5\ \mu$  in diameter)



- (I) Stratum bright blue-green, membranaceous, expanded; filaments elongate, more or less straight, closely intermeshed; sheaths thin, diffuent into an apparently fibrous mucus, coloring blue when treated with chlor-zinc-iodine; trichomes bright blue-green, not at all or very slightly constricted at the cross-walls, often indistinctly articulated, at first straight then uncinatate and attenuate at the apices, 1–2  $\mu$  in diameter; cells 2.5–5  $\mu$  long; protoplasm homogeneous; apical cell often acute-conical, without calyptra. . . . . *P. tenue*
- (II) Stratum lubricous, expanded, lamellose, up to 3 cm. thick, dirty green above, colorless beneath; filaments flexuous, closely interwoven; sheaths well defined and papery, later diffuent into a tenacious mucus, coloring blue when treated with chlor-zinc-iodine; trichomes blue-green, straight at the apices, not attenuated, never constricted at the cross-walls, 2–2.5  $\mu$  in diameter; cells longer than wide, 3.3–6.7  $\mu$  long; protoplasm finely granular, the cross-walls marked with two or four granules; apical cell rotund, without calyptra. . . . . *P. valderianum*
- (III) Stratum blackish or brownish-green, expanded, membranaceous, coriaceous; filaments elongated, more or less flexuous, closely interwoven; sheaths thin, distinct, or diffuent into an amorphous mucus coloring blue when treated with chlor-zinc-iodine; trichomes blue-green, not constricted at the cross-walls, briefly attenuated, 3–4.5  $\mu$  in diameter; cells subquadrate to twice as long as wide, 3.4–8  $\mu$  long; protoplasm seldom granulose; cross-walls usually conspicuous, not granulated; apical cell acute-conical, without calyptra. . . . . *P. Corium*
- (IV) Stratum blackish-green or blue-green, expanded, shining, thin but tough, fragile when dried, in fresh or somewhat brackish water; filaments elongate, rather flexuous, very closely interwoven; sheaths thin and papery or entirely diffuent, coloring blue when treated with chlor-zinc-iodine; trichomes bright blue-green, slightly or not at all constricted at the cross-walls, straight and briefly attenuate at the apices, 3–5  $\mu$  in diameter; cells subquadrate or shorter than wide, 2–5  $\mu$  long; protoplasm often granulose; cross-walls conspicuous, never granulated; apical cell obtuse-conical, without calyptra. *P. papyraceum*
- b. Trichomes broad (seldom found less than 4.5  $\mu$  in diameter)
- (I) Plant mass bright blue-green or bluish-black, thick, compact, or rarely fasciculate-penicillate and attached at the base, in fresh water; filaments more or less straight, fragile; sheaths thin, usually more or less diffuent

into an amorphous mucus, not coloring blue when treated with chlor-zinc-iodine; trichomes blue-green, not constricted at the cross-walls, or only so at the apices, rarely here and there almost torulose, straight and briefly attenuate at the apices,  $4.5-12\ \mu$  in diameter; cells longer or shorter than wide,  $4-8\ \mu$  long; protoplasm coarsely granulose; cross-walls conspicuous, usually ungranulated; apical cell briefly and scarcely attenuate, truncate, with a slightly thickened outer membrane. . . . . *P. Retzii*

- (II) Stratum expanded, bright blue-green, yellowish-green, or blackish, in fresh (and slightly brackish) water; filaments elongated, flexuous, variously interwoven; sheaths firm or mucous and diffuent, in some collections thick and lamellose, coloring blue when treated with chlor-zinc-iodine; trichomes bright blue-green, slightly constricted at the cross-walls, straight and not attenuate at the apices,  $4-6$  ( $-7$ )  $\mu$  in diameter; cells  $1.5-2.7\ \mu$  long; protoplasm usually rather coarsely granulose; cross-walls rarely granulated; apical cell rotund, its outer wall somewhat thickened. . . . . *P. ambiguum*

B. Trichomes conspicuously calyptrate; apical cell in some species enlarged and capitate

1. Cells of most trichomes of the plant-mass quadrate and shorter than wide.—Stratum expanded, fragile, dark blue-green, often yellowish-brown, subaerial or aerial in freshwater or secondarily brackish habitats; filaments straight, fragile, parallel, or variously intertwined; sheaths well defined, mucous, or diffuent into an amorphous jelly, never coloring blue when treated with chlor-zinc-iodine; trichomes blue-green or olive-green, never constricted at the cross-walls, capitate, briefly attenuate and scarcely curved or straight at the apices,  $4-7\ \mu$  in diameter; cells  $2-5\ \mu$  long; protoplasm granulose; cross-walls frequently granulated; apical cell enlarged, bearing a more or less rotund calyptra. . . . . *P. autumnale*
2. Cells of most trichomes of the plant-mass quadrate or longer than wide.—Stratum membranaceous, coriaceous, dark green or bright blue-green, in salt water; filaments straight or variously contorted, often parallel or intermeshed; sheaths thin, often distinct and imbedded in an amorphous mucus, or as often wholly diffuent, not coloring blue when treated with chlor-zinc-iodine; trichomes bright blue-green (rarely lead-colored in dried material), constricted at the cross-walls, often distinctly torulose, straight and perceptibly long-attenuate at the apices, often almost capitate,  $2.7-5.5\ \mu$  in diameter; cells subquadrate to twice as long as wide,  $3-10\ \mu$  long; protoplasm finely granulose; cell-walls never granulated; apical cell obtuse-conical, bearing a depressed-conical calyptra. . . . . *P. submembranaceum*



**PHORMIDIUM MUCICOLA** Naum. & Huber in Huber-Pestalozzi & Naumann, Ber. d. d. bot. Ges. **47**: 68, f. 1-6 (1929).—Thus far observed in southern Massachusetts only in the sheaths of *Microcystis aeruginosa* Kütz. Dr. G. Huber-Pestalozzi has obligingly compared a duplicate of the second collection cited below with the original material of this species, which besides having been found at several stations in Europe has been reported by Rich from Kenya Colony in Journ. Linn. Soc. Zool. **38**: 271 (1933). I shall treat specimens from Argentina in another publication. The trichomes in our material are pale blue-green and often give one reason to suspect that they are rod-shaped bacteria, though masses of trichomes in the same *Microcystis* colony have a definite blue-green color. In well delimited colonies of *Microcystis*, the filaments occur in small numbers in the periphery of the jelly. A correlation appears to exist between the degree of diffuence of the sheaths and the number of *Phormidium* filaments present. In colonies which have become almost entirely dissociated, the filaments are often more numerous than the *Microcystis* cells. Where many *Phormidium* filaments are present, the cells of *Microcystis* often contain neither conspicuous pseudovacuoles nor evident cell membranes and acquire the yellowish-green color associated with the death of the organisms. From similar observations, the authors of the species supposed *P. mucicola* to be at least partially parasitic and ultimately to cause the death of the 'host' cells. Geitler in Rabenh. Kryptogamen-Fl. **14**: 999 (1932) has pointed out that the death of these cells may be due to other factors and that the *Phormidium* filaments may multiply and occupy the entire jelly of the 'host' colony only because the 'host' cells have disappeared from it. Specimens seen from the United States: MASSACHUSETTS: Falmouth: Coonamesset Pond, Hatchville, H. Croasdale, 4 Aug. 1934 (D, F, N, S, T, W); Oyster Pond, E. T. Ross, 17 June 1936 (D, Huber-Pestalozzi); 'Episcopal Ocean,' A. Cohen & Drouet 1910, 12 Aug. 1936 (D). INDIANA: with and sub. nom. *Microcystis aeruginosa*, Winona Lake, C. M. Palmer, 30 Aug. 1935 (D). MICHIGAN: McDonald Lake, Hastings, G. T. Velasquez 16, 4 Aug. 1936 (D, F, T, Y, Herb. Univ. Mich., Velasquez). IOWA: plankton from Center Lake, G. W. Prescott 317, 10 July 1925 (D, F); Miller's Bay, Lake Okoboji, Prescott 316, 30 June 1925 (D); Lake East Okoboji, Prescott 338, 24 June 1926 (D, N, S).

**PHORMIDIUM PERSICINUM** (Reinke) Gom., Ann. Sci. nat. VII Bot. **16**: 164 (1892); Davis, Phyc. Bor.-Amer. **29**: 1401 (1907), in certain specimens distributed; Tilden, Minn. Alg. **1**: 94 (1910), in part; Davis, Bull. U. S. Bur. Fish. 1911(2): 798 (1913), in part.—Fig. 6. If a normal constituent of the flora, rarely observed or rarely attaining conspicuous growth. Some duplicate specimens of the one collection cited below contain very little if any of this species; for example, that in the Herbarium of W. R. Taylor consists almost entirely of *Oscillatoria laetevirens*. Three sheets of a collection, two in the Farlow Herbarium and one in the New York Botanical Garden, 'forming thin

layers on the glass of a marine aquarium, Woods Holl, *Trelease*, 28 Sept. 1881,' contain a small form with trichomes somewhat similar to *P. Ectocarpi* Gom, Bull. Soc. Bot. France **46**: 37 (1899), as described; but the sheaths do not color blue when treated with chlor-zinc-iodine. M. Gomont apparently saw a duplicate of this material, for one sheet in the Farlow Herbarium is annotated in Prof. Farlow's handwriting with an extract from a letter from Gomont in 1907: "Me paraît un petit *Phormidium* voisin de *Ph. Ectocarpi* Gom., *Nostoc. Homo.*, mais la couleur différent." I am not in a position to place this material with certainty and therefore omit it here. One collection of *P. persicinum*: FALMOUTH: in a jar in the Marine Biological Laboratory, Wood's Hole, *B. M. Davis*, May 1907 (Phyc. Bor.-Amer. 1401, N, W, Y, in part; not T).

*PHORMIDIUM FRAGILE* (Menegh.) Gom., Ann. Sci. nat. VII Bot. **16**: 163, pl. iv, f. 13-15 (1892). [?] *P. tenue* of Hazen, RHODORA **26**: 211 (1924); Croasdale, Fresh Water Alg. Woods Hole, Mass., 20 (1935), in part, not Gom.—Apparently confined here to saline and subsaline habitats, and often confused with *P. tenue*. The Fairhaven material is similar to that of a specimen determined by Gomont in the Farlow Herbarium, MAINE: Seal Harbor, *F. S. Collins* 1867, July 1891; the Penikese specimens are referred here though many trichomes in the masses have cells somewhat longer than broad. Specimens seen: FAIRHAVEN: tide-pools on Black Rock, *W. R. Taylor*, 31 July 1917 (T); Sconticut Point, *Drouet* 2176, 1 Sept. 1937 (D, F, N, S). GOSNOLD: on rocks in a tide pool, Penikese Island, *J. Cohn*, 10 July 1934 (D, Y); Botanical Survey of Penikese Island, 24 July 1923 (W).

*PHORMIDIUM MOLLE* (Kütz.) Gom., Ann. Sci. nat. VII Bot. **16**: 163, pl. iv, f. 12 (1892).—*Fig. 7*. Known from a single specimen: BOURNE: Iron Works Pond, *F. S. Collins*, 6 Aug. 1915 (N).

*PHORMIDIUM TINCTORIUM* Kütz. ex Gom., Ann. Sci. nat. VII Bot. **16**: 162, pl. iv, f. 11 (1892); Croasdale, Fresh Water Alg. Woods Hole, Mass., 19 (1935). Authentic material: Rabenh. Alg. 1994 (F); Desmaz., Pl. cryptog. France, éd. I, 1969 (F).—One collection: GOSNOLD: penicillate tufts attached to decaying sticks in a well-hole the water of which empties into Sheep Pond, Cuttyhunk Island, *Drouet* 1004, 1 July 1930 (T, D).

*PHORMIDIUM LURIDUM* (Kütz.) Gom., Ann. Sci. nat. VII Bot. **16**: 165, pl. iv, f. 17, 18 (1892). Authentic material: Desmaz., Pl. cryptog. France, sér. II, 129 (F).—Known from one station: FALMOUTH: lining concrete tanks beneath benches in greenhouse south of railroad station, Woods Hole, *Drouet* 1931, 27 Aug. 1936 (D, F, T, Y).

*PHORMIDIUM TENUE* (Menegh.) Gom., Ann. Sci. nat. VII Bot. **16**: 169, pl. iv, f. 23-25 (1892); Nott, Phyc. Bor.-Amer. **13**: 606 (1899), at least in part; Tilden, Minn. Alg. **1**: 98 (1910); Croasdale, Fresh Water Alg. Woods Hole, Mass., 20 (1935); not of Hazen, RHODORA **26**: 211 (1924). *P. angustissimum* of Croasdale, *ibid.* 19 (1935), not West & West f., ex char. Authentic material: Rabenh. Alg. 268 (F),



1730 (F, T).—Often seen in fresh water and very rarely in slightly brackish water. Phyc. Bor.-Amer. 606 consists of a considerable number of species of algae not carefully dried and partially overgrown by fungi. The masses of trichomes purported to be *P. tenue* are at most in a juvenile state and are scarcely sufficiently large for critical study. Morphologically the trichomes seem referable rather to *P. tenue* than to *P. angustissimum* as described. Specimens seen: FALMOUTH: on sides of a watering-trough, Woods Hole, *Drouet 1905*, 5 Aug. 1936 (D, F, S, T, Y). GOSNOLD: Deer Pond, Nonamesset Island, *H. Croasdale*, 2 July 1934 (D, Y); pool, east shore of Naushon Island, *C. P. Nott*, 9 Aug. 1895 (W, *Specim. mancum*); in fresh water, Naushon Island, *C. P. Nott*, 9 Aug. 1895 (Phyc. Bor.-Amer. 606, W, T, Y, *specim. manca*).

PHORMIDIUM VALDERIANUM Gom.,<sup>12</sup> Ann. Sci. nat. VII Bot. 16: 167, pl. iv, f. 20 (1892). Authentic material: Rabenh. Alg. 577 (F), 2458 (F); Hauck & Richt., Phyk. univ. 29 (F).—In fresh water. In the authentic material cited above, in the many specimens of this species from Europe and America studied during preparation of this paper, and in Gomont's illustration (loc. cit.) of this species, I have been unable to discover the constrictions of the trichomes as described by Copeland, Ann. New York Acad. Sci. 36: 179 (1936). The material which Croasdale reported as 'rare' in Chara Pond near Woods Hole in her *Fresh Water Alg. Woods Hole, Mass.*, 20 (1935), has been lost; I have not had the opportunity to examine it. The one collection seen lined a trough through which hot and cold water ran intermittently: FALMOUTH: Ice House Pond, *E. T. Rose*, 25 June 1936 (D, F, T, Y).

PHORMIDIUM CORIUM (Ag.) Gom. ex Ann. Sci. nat. VII Bot. 16: 172, pl. v, f. 1, 2 (1892). Authentic material: Rabenh. Alg. 294 (F, T), 392 (F).—Growing subaerially in leathery sheets, or in thick compact strata beneath the surface of fresh water. *P. inundatum*, *P. papyraceum*, and *Symploca muralis* are sometimes confused with this species. Specimens seen: FAIRHAVEN: lining walls of a cow-trough and well by Highway 6 east of Fairhaven, *E. T. Rose & Drouet 1889*, 18 July 1936 (D, F, T, Y). TISBURY: on stones in springy margins of south end of Lake Tashmoo, *G. Velasquez & Drouet 1894*, 21 July 1936 (D, S).

PHORMIDIUM PAPHYRACEUM (Ag.) Gom., Ann. Sci. nat. VII Bot. 16: 173, pl. v, f. 3, 4 (1892). Authentic material: Wittr. & Nordst., Alg. exs. 776a, b (F); Rabenh. Alg. 2089 (F); Hauck & Richt., Phyk. univ. 223 (F).—Forming dark blue-green sheets in almost fresh water of high tide pools (diluted with rain water), or in comparable situations in which the salt content of the water is low. Specimens in herbaria come also from strictly freshwater habitats. *P. papyraceum* is reported by Taylor, RHODORA 26: 212 (1924), from Penikese Island; unfortunately the specimen has been misplaced. Specimens seen:

<sup>12</sup> This name is incorrectly written *P. valderianum* (Delp.) Gom. in recent phycological literature.

FAIRHAVEN: in high tide pools, Sconticut Point, *Drouet* 1879, 1880, 15 July 1936 (D, F, S, T, Y).

PHORMIDIUM RETZII (Ag.) Gom. ex Ann. Sci. nat. VII Bot. 16: 175, pl. v, f. 6-9 (1892); Collins, Phyc. Bor.-Amer. 35: 1710 (1911); not of Croasdale, Fresh Water Alg. Woods Hole, Mass., 20 (1935). Authentic material: Kütz. Dec. 15 (F); Moug. & Nestl., Stirp. crypt. vogeso-rhenanae 1375 (F).—One collection seen: EASTHAM: forming sheaths on stalks of plants in shallow water, Great Pond, *F. S. Collins*, 9 Sept. 1910 (Phyc. Bor.-Amer. 1710, W, T, Y).

PHORMIDIUM AMBIGUUM Gom., Ann. Sci. nat. VII Bot. 16: 178, pl. v, f. 10 (1892). *Lyngbya semiplena* of Nott, Phyc. Bor.-Amer. 30: 1452a (1908); not of Setchell, idem 1452b (1908); not J. Ag. ex Gom. Authentic material: Rabenh. Alg. 75 (F, T), 265 (F), 1956 (F); Wittr. & Nordst., Alg. exs. 492 (F).—Specimens seen, all apparently from fresh water: FALMOUTH: on stones in running water flowing from pond to the sea, 'Megantic,' Buzzards Bay, *W. G. Farlow*, Aug. 1913 (F); on mud and debris in shallow water, Wood Pond, Woods Hole, *Drouet* 1107, 23 June 1934 (D, F, T, Y); ditch, Falmouth, *C. P. Nott*, 20 July 1895 (W), July 1895 (Collins, N. Amer. Alg. 12, D), undated (Phyc. Bor.-Amer. 1452a, not b, W, T, Y).

PHORMIDIUM AUTUMNALE (Ag.) Gom., Ann. Sci. nat. VII Bot. 16: 187, pl. v., f. 23, 24 (1892); Croasdale, Fresh Water Alg. Woods Hole, Mass., 20 (1935). *P. favosum* of Collins, Phyc. Bor.-Amer. 34: 1852 (1910), not Gom. *Lyngbya hahatonkensis* *Drouet*,<sup>13</sup> Bot. Gaz. 95: 698, f. 5 (1934). Authentic material: Kütz. Dec. 94 (F); Rabenh. Alg. 2537 (F); Hauck & Richt., Phyk. univ. 233 (F).—Often developing on soil in and about temporary rain pools, rarely in subaerial subsaline habitats, and not seldom appearing in soil cultures. Specimens seen: EASTHAM: forming a thin glossy coating on wall of a spring at high water mark, shore of Salt Pond, *F. S. Collins*, 11 Sept. 1910 (Phyc. Bor.-Amer. 1652, W, T, Y). FALMOUTH: subaerial on wet soil behind Zoology Building, Woods Hole, *Drouet* 1926, 22 Aug. 1936 (D, F, T, Y); in clay drain pipe beside Eel Pond, Woods Hole, *Drouet* 1183, 30 July 1934 (D); on wet earth in greenhouse south of railroad station, Woods Hole, *Drouet* 1932, 27 Aug. 1936 (D); damp ground near a pump, Wood's Holl, *W. A. Setchell*, July 1894 (W); on wet soil in greenhouse at railroad station, Falmouth, *Drouet* 1936, 29 Aug. 1936 (D); in greenhouse by State Road at Church Street, Woods Hole, *Drouet* 1930, 26 Aug. 1936 (D).

PHORMIDIUM SUBMEMBRANACEUM (Ard. & Straff.) Gom., Ann. Sci. nat. VII Bot. 16: 180, pl. v, f. 13 (1892); Osterhout & Gardner, Phyc.

<sup>13</sup> The TYPE material of this species, MISSOURI: Hahatonka, *Drouet* 148, 9 Aug. 1928, in Herb. F. Drouet, should more reasonably be considered an ecological or growth form of *P. autumnale* than a species of *Lyngbya*. The shortness of the cells can easily be attributed to a high rate of cell division taking place in a rapidly developing plant mass. The trichomes in other respects appear to be identical with authentic material of *P. autumnale*. Thick and mucous sheaths are seen in other material of this species growing in almost or partially submersed habitats.



Bor.-Amer. **24**: 1162 (1904); Tilden, Minn. Alg. **1**: 104 (1910); Geitler, Rabenh. Kryptogamen-Fl. **14**: 1023 (1932); Frémy, Mém. Soc. nat. Sci. nat. & math. Cherbourg **41**: 91 (1834). *Oscillatoria* (*Oscillaria*) *subtorulosa* Farlow (as to specimens, not as to name-bearing synonym of *Phormidium subtorulosum* Bréb. ex Gom.) apud Tilden, Minn. Alg. **1**: 83 (1910); Farlow, Mar. Alg. New Engl., 33 (1891); not of Davis, Bull. U. S. Bur. Fish. 1911(2): 797 (1913).—In a letter to Prof. Farlow presumably written in August, 1899, M. Gomont speaks of the former's collection from Eastport, Maine, labeled *Oscillaria subtorulosa*, a portion of which he examined and returned:<sup>14</sup> "Votre plante est un Phormidium, épais de 3–4  $\mu$ , à articles carré, à extrémité droite, avec un coiffe. Il ressemble beaucoup au Phormidium submembranaceum (Oscill. Ardissonae) et je crois qu'on peut le réunir à cette espèce dont je n'ai vu qu'un seul échantillon, celui d'Ardissonae." This specimen and other New England material appear to be exactly similar in every morphological detail except range in size to Phyc. Bor.-Amer. 1162 from California, the apparent basis for the citation of this species from North America by Geitler, loc. cit., and by Frémy, loc. cit. The species is one of truly marine waters, often found mixed with other algae on piers, wharves, barnacles, and rocks both between and below tide marks. Prof. Frémy has examined a portion of Farlow's material of *O. subtorulosa*. Specimens seen from North America: MAINE: Eastport, *W. G. Farlow*, Oct. 1875 (F, P, Y). MASSACHUSETTS: Medford: *F. S. Collins*, 21 May 1877 (N). Falmouth: on government wharf, Wood's Holl, *W. G. Farlow*, Aug. 1876 (F); on barnacles from planks, Eel Pond, Woods Hole, *W. R. Taylor*, 18 July 1925 (T); on barnacles, bridge at entrance to Eel Pond, Woods Hole, *W. R. Taylor*, 22 July 1921 (T); on pilings, Penzance Garage, Woods Hole, *Drouet 2131*, 14 Aug. 1937 (D, F, N, S, W). RHODE ISLAND: Newport, *I. Holden*, 9 May 1896 (F). CONNECTICUT: Black Rock, Bridgeport, *I. Holden*, 20 July 1892 (F, N). CALIFORNIA: Alameda, *W. J. V. Osterhout & N. L. Gardner*, 26 Sept. 1903 (Phyc. Bor.-Amer. 1162, T, Y).

OSCILLATORIA Vauch. ex Gom., Ann. Sci. nat. VII Bot. **16**: 198 (1892). *Oscillaria* of various authors.—One must be exceedingly careful, before determination of species in this and other genera is attempted, to exclude material in the hormogonial condition. Often thin and mucous sheaths are secreted about the hormogonia and give the appearance of a phormidioid or lyngbyoid plant mass. With the trichomes broken into short segments, the chances of discovering the maturely developed apices become very rare.<sup>15</sup>

<sup>14</sup> M. Gomont's letters to Prof. Farlow are to be found on file with other scientific correspondence of the latter in the Farlow Reference Library of Harvard University.

<sup>15</sup> Certain characters other than those employed in this paper have been suggested (see Geitler, Rabenh. Kryptogamen-Fl. **14**. 1930–32) as having taxonomic importance in the genus *Oscillatoria*: the direction of rotation of the living trichomes, the refraction of blue light by the cell-membranes or unseen sheaths, the reversible vacuolization of the protoplasm ('keritomy'), the presence of refractive accumulations within

Certain species often encountered in North America are here omitted from treatment because of absence of preserved material from southern Massachusetts; among these are *O. sancta* Kütz. ex Gom., *O. limosa* Ag. ex Gom., *O. curviceps* Ag. ex Gom., *O. rubescens* DC. ex Gom., *O. prolifica* (Grev.) Gom., *O. Agardhii* Gom., *O. animalis* Ag. ex Gom., *O. chalybea* Mert. ex Gom., *O. Okeni* Ag. ex Gom., *O. terebriformis* Ag. ex Gom., and *O. Grunowiana* Gom. I have been unable to locate the material upon which Croasdale based her reports of *O. nigra* and *O. angustissima* in *Fresh Water Alg. Woods Hole, Mass.*, 17 (1935) and hence exclude such reports from treatment here. *O. subuliformis* of Hazen, RHODORA 26: 215 (1924), is considered in this paper under *O. brevis* var. *neapolitana*.

#### KEY TO SPECIES

- I. Forms with large trichomes (6-60  $\mu$  in diameter), the majority of cells in the plant mass less than 1/3 as long as wide
  - A. Plants strictly of fresh water, rarely found in secondarily brackish water
    1. Cross-walls never granulated; apices of trichomes capitate or subcapitate
      - a. Plant-mass dark blue-green; trichomes dark blue-green, straight, rigid, fragile, not constricted at the cross-walls, 16-60 (usually 25-50)  $\mu$  in diameter, at the apices somewhat attenuate and more or less uncinatate, subcapitate and uncinatate; cells 1/4-1/11 as long as wide; protoplasm finely, often coarsely, granulose; apical cell convex, without calyptra. . . . . *O. princeps*
      - b. Plant-mass dark blue-green; trichomes bright blue-green, often mixed sparingly with other algae, straight or subflexuous, here and there uncinatate-spiraled, never constricted at the cross-walls, 12-15  $\mu$  in diameter, at the apices briefly and often conspicuously attenuate-capitate, or truncate and uncinatate or loosely terebriform; cells 1/3-1/6 (usually 1/4) as long as wide, 2-4  $\mu$  long; protoplasm finely granulose; cross-walls conspicuous, never granulated; membrane of the apical cell convex and slightly thickened. . . . . *O. proboscidea*
    2. Cross-walls always granulated; apices of trichomes capitate only in *O. anguina*
      - a. Stratum blackish-green; trichomes somewhat torulose, straight below but somewhat spiraled and uncinatate toward the apices, long and very slightly attenuated, not capitate, 9-11  $\mu$  in diameter; cells 1/2-1/6 as long as wide; apical cell rotund, without calyptra. . . . . *O. ornata*
      - b. Stratum blackish-green; trichomes straight below,

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or in conjunction with the apical cells, the thickness of cross-walls, and the presence of 'intercellular spaces.' Extended studies of such characters in well authenticated material of the more common species are much to be desired.

uncinate or conspicuously spiraled above, somewhat long-attenuate, obtusely capitate, not constricted at the cross-walls, 6–8  $\mu$  in diameter; cells 1/3–1/6 as long as wide; apical cell enlarged, rotund, the outer membrane thickened. . . . .

*O. anguina*

- B. Plants strictly of salt or brackish water, rarely if ever found in fresh water

1. Plant-mass black; trichomes bright olive-green, straight, fragile, torulose, at the apices attenuate and noticeably arcuate, 17–29  $\mu$  in diameter; cells 1/3–1/7 as long as wide; protoplasm finely granulose; cross-walls coarsely granulated; apical cell rotund, seemingly capitate, the outer membrane thickened into a conspicuous convex calyptra. . . . .

*O. margaritifera*

2. Plant-mass blackish or olive-green; trichomes olive-green, elongate, straight, torulose, toward the apices long and conspicuously attenuate and arcuate, 7–11  $\mu$  in diameter; cells 1/2–1/4 as long as wide; cross-walls conspicuously granulated; apical cell seemingly subcapitate, rotund, the outer membrane thickened. . . . .

*O. nigro-viridis*

- II. Forms with small trichomes (10  $\mu$  or less in diameter); the greater number of cells in the plant mass more than 1/3 as long as wide

- A. Trichomes not attenuate at the apices, nor capitate with an enlarged apical cell

1. 1. Cells quadrate and shorter than wide.—Plant-mass bright or dark blue-green, in fresh water; trichomes brilliantly blue-green, straight, fragile, constricted at the cross-walls, straight or arcuate at the apices, 4–10  $\mu$  in diameter; cells subquadrate to 1/3 as long as wide; protoplasm coarsely granulose; cross-walls conspicuously granulated; apical cell rotund, with a thickened outer membrane. . . . .

*O. tenuis*

2. Cells quadrate and longer than wide

a. Stratum thin and web-like, yellowish-green, in fresh water; trichomes greenish-yellow, straight or curved, often arcuate at the apices, not constricted at the cross-walls, 3.5–4  $\mu$  in diameter; cells subquadrate to twice as long as wide; protoplasm scarcely granulose; cross-walls pellucid, ungranulated; apical cell rotund at the apex, without calyptra. . . . .

*O. chlorina*

b. Stratum thin, bright blue-green, in fresh or brackish water; trichomes very pale green, straight, fragile, not constricted at the cross-walls, arcuate at the apices, 2–3  $\mu$  in diameter; cells 2–3 times as long as wide; protoplasm scarcely granulose; cross-walls usually marked with two large protoplasmic granules; apical cell rotund above, without calyptra. . . . .

*O. amphibia*

- B. Mature trichomes attenuate at the apices

1. Trichomes capitate with an enlarged apical cell.—Plant-mass bright blue-green, thin, in fresh water; trichomes pale blue-green, straight or flexuous, elongate, not constricted at the cross-walls, long-attenuate and conspicuously capitate at the apices, 2–3  $\mu$  in diameter; cells rarely subquadrate, up to 4 times as long as wide; protoplasm homogeneous;



- cross-walls granulated; apical cell enlarged above, without calyptra.....*O. splendida*
2. Trichomes not capitate with an enlarged apical cell
- a. Trichomes not constricted at the cross-walls
- (I) Apical cell truncate.—Stratum bright blue-green, in fresh or brackish water; trichomes bright blue-green (rarely yellowish-green or lead-colored), straight or undulate below, long-attenuate and briefly uncinata or spiraled at the apices, 3–5  $\mu$  in diameter; cells as a rule subquadrate, often longer or shorter than wide, 2–6  $\mu$  long; protoplasm finely granulose; cross-walls often conspicuous, often coarsely granulated; apical cell truncate, the outer membrane somewhat thickened.....*O. granulata*
- (II) Apical cell acute-conical.—Stratum olive-green; trichomes blue-green, straight, briefly and subacutely attenuated and uncinata or spiraled at the apices, 4–6.5  $\mu$  in diameter; cells 1/3–1/2 as long as wide, protoplasm finely granulose; cross-walls not granulated; calyptra absent
- (A) Freshwater form, with trichomes 4–5  $\mu$  in diameter, the apices uncinata.....*O. brevis*
- (B) Brackish or salt water form, with trichomes 5–6.5  $\mu$  in diameter, the apices uncinata or spiraled.....*O. brevis* var. *neapolitana*
- b. Trichomes constricted at the cross-walls, at least at the apices
- (I) Stratum yellowish or yellow-green, thin, not rarely almost membranaceous, fragile, submerged in brackish water, rarely emersed and subaerial, usually intermixed with various other Oscillatoriaceae; living trichomes yellow-green, straight, rarely somewhat flexible, fragile, evidently constricted at the cross-walls, never torulose, 3–5  $\mu$  in diameter, straight or rarely scarcely curved or uncinata at the apices, very briefly attenuate; cells subquadrate to 1/3 as long as wide, 1.5–5.5  $\mu$  long; protoplasm finely granulose throughout the cell; cross-walls conspicuous, pellucid, never granulated; apical cell obtusely cylindric-conical, never capitate or calyptrate.....*O. luteola*
- (II) Stratum bright green, in salt water; trichomes somewhat yellowish-green or blue-green, straight, fragile, slightly constricted at the cross-walls or almost torulose, briefly attenuate and undulate or uncinata at the apices, 3–5  $\mu$  in diameter; cells subquadrate; protoplasm uniformly granulose; cross-walls evident, sometimes punctate; apical cell more or less obtuse to subacute-conical, without calyptra.....*O. laetevirens*
- (III) Stratum blue-green, in fresh water; trichomes straight, elongate, usually constricted at the cross-walls and always so at the apices, briefly and subobtusely attenuate and uncinata, 4–6  $\mu$

in diameter; cells quadrate to 1/2 as long as wide; protoplasm finely granulose; cross-walls granulated; apical cell blunt-conical, without calyptra.....*O. formosa*

**OSCILLATORIA PRINCEPS** Vauch. ex Gom., Ann. Sci. nat. VII Bot. 16: 206, pl. vi, f. 9 (1892); Croasdale, Fresh Water Alg. Woods Hole, Mass., 17 (1935). *Lyngbya gigantea* Lewis, Zirkle & Patrick,<sup>16</sup> Journ. Elisha Mitchell Sci. Soc. 1933: 221, pl. 16, f. 7 (1933). Authentic material: Farl., Anders. & Eat., Alg. Am. Bor. Exs. 177 (F, Y); Rabenh. Alg. 580 (T), 1122 (F), 1218 (F), 2535 (F, T); Wittr. & Nordst., Alg. exs. 393a, b (F).—Not uncommon in quiet fresh water. Specimens seen: FALMOUTH: in a pond, *H. Croasdale*, 16 July 1934 (D); cranberry pond north of West Falmouth, *E. T. Rose*, 13 July 1936 (D, N, S); Beebe's Pond near Falmouth, *H. Croasdale* (W); waterhole in bog near Chara Pond, *Drouet* 1942, 14 Sept. 1936 (D). DARTMOUTH: in a pond 1 mile south of Nonquitt, *E. T. Rose & Drouet* 1890, 18 July 1936 (D, F, T, Y).

**OSCILLATORIA PROBOSCIDEA** Gom., Ann. Sci. nat. VII Bot. 16: 209, pl. vi, f. 10, 11 (1892). Authentic material: Rabenh. Alg. 2535 (F).—In fresh water: FALMOUTH: Shiverick Pond, *Drouet* 2180, 4 Sept. 1937 (D, F, N, S); on submerged water plants in sewage, 'Episcopal Ocean,' *E. T. Rose & Drouet* 1869, 4 July 1936 (D, F, S, T, Y).

**OSCILLATORIA ORNATA** Kütz. ex Gom., Ann. Sci. nat. VII Bot. 16: 214, pl. vi, f. 15 (1892). Authentic material: Moug. & Nestl., Stirp. crypt. vageso-rhenanae 898 (N, in part, not F).—Specimens seen: GOSNOLD: Cuttyhunk, *W. R. Taylor*, 27 July 1926 (T). DARTMOUTH: with *O. princeps* in a pond 1 mile south of Nonquitt, *E. T. Rose & Drouet* 1890, 18 July 1936 (D, F, T, Y).

**OSCILLATORIA ANGUINA** Bory ex Gom., Ann. Sci. nat. VII Bot. 16: 214, pl. vi, f. 16 (1892); Croasdale, Fresh Water Alg. Woods Hole, Mass., 17 (1935).—Often abundant in masses of other algae in ponds and bogs. Specimens seen: FALMOUTH: Fresh Pond, Nobska Point, *Drouet* 1949, 16 Sept. 1936 (D); with *Phormidium ambiguum* on mud and debris in shallow water, Wood Pond, Woods Hole, *Drouet* 1107, 23 June 1934 (D). GOSNOLD: Pink Pond, Nonamesset Island, *H. Croasdale*, 2 July 1934 (D); with other algae on the bottom of Nashawena Pond, Nashawena Island, *Drouet* 1874, 8 July 1936 (D, F, N, S, T, Y).

**OSCILLATORIA MARGARITIFERA** Kütz. ex Gom., Ann. Sci. nat. VII Bot. 16: 216, pl. vi, f. 19 (1892); Taylor and Hazen, RHODORA 26: 212, 215 (1924), in part; Croasdale, Fresh Water Alg. Woods Hole, Mass., 17 (1935), in part; not of Collins, Phyc. Bor.-Amer. 35: 1708a, b (1911). Authentic material: Hauck & Richt., Phyk. univ. 474

<sup>16</sup> I am indebted to the authors, and especially to Dr. Conway Zirkle, for the privilege of examining the TYPE material of this species. I interpret the specimens as trichomes of *O. princeps* in the hormogonial state, as the description and figure suggest.

(F, in part).—Forming slimy black expansions in shallow salt marshes and brackish ponds; often seen mixed with other algae in similar habitats. *Hydrocoleum glutinosum* and *H. Hödenii*, which are probably more abundant in salt marshes about Woods Hole than is *O. margaritifera*, are often mistaken for this species. Specimens seen: FALMOUTH: on bottom of Mill Pond, Woods Hole, *Drouet* 1945, 17 Sept. 1936 (D, F, N, S, T, Y), *Drouet* 2178, 2 Sept. 1937 (D, N, S). GOSNOLD: Botanical Survey of Penikese Island, 24 July 1923 (W); on bottom and floating in Tub Pond north, Penikese Island, *Drouet* 1864, 1 July 1936 (D, N, S).

*OSCILLATORIA* *NIGRO-VIRIDIS* Thw. ex Gom., Ann. Sci. nat. VII Bot. 16: 217, pl. vi, f. 20 (1892). *O. lactevirens* of Davis, Bull. U. S. Bur. Fish. 1911(2): 798 (1913), not Crouan ex Gom. Authentic material: Hauck & Richt., Phyk. univ. 186 (F).—Often found floating, or covering rocks, woodwork, barnacles, or other algae in quiet salt, seldom in brackish, water. Our specimens from salt water invariably measure 7  $\mu$  in diameter, the lower limit of measurement as described by Gomont; in only one specimen seen, my 1934 from brackish water cited below, do the trichomes approach the maximal width of 11  $\mu$ . Gomont described this species as inhabiting typically, “ad summum limitem maris, palos, portuum muros, rupes limosas, necnon ostia coenosa fluminum,” etc. and *O. Corallinae* Gom., distinguished from *O. nigro-viridis* by the habit of growth and the type of protoplasmic granulation, as typically “in Corallinis aliisque algis necnon Zoophytis parasitica, infra limitem superiorem maris,” etc. On the New England coast, at least, the same morphological type grows indiscriminately upon rocks, wood, attached animals, and other algae, usually at low tide level. Often the cross-walls are not as conspicuously granulated as in Gomont’s figure of *O. nigro-viridis* and in the authentic material cited above, but much more so than in Crouan, Alg. Mar. Finistère 329 (F), cited as authentic material of *O. Corallinae*. Material from collections cited below has been seen by Prof. Frémy and Prof. Geitler. Specimens examined: FALMOUTH: on woodwork, Eel Pond, Woods Hole, *F. S. Collins*, 15 Aug. 1904 (as *O. lactevirens*, N), *Drouet* 1119, 27 June 1934 (D); on government wharf at high water mark, Wood’s Holl, *W. G. Farlow*, Aug. 1876 (F); on submerged *Fucus*, Eel Pond, Woods Hole, *Drouet* 1203, 29 July 1934 (D); on *Enteromorpha*, Eel Pond, Woods Hole, *Drouet* 1012, 12 July 1930 (D); on stumps of *Spartina* etc. in a pool south of Chara Pond, *Drouet* 1934, 18 Aug. 1936 (D, F). OAK BLUFFS: on algae dredged off East Chop, *H. Croasdale*, 15 July 1930 (D). FAIRHAVEN: on Rhizoclonium and rocks, tide pool, Black Rock, *Drouet* 1196, 22 July 1934 (D, F, N, T, Y, Frémy, Geitler); Sconticut Point, *Drouet* 1218, 22 July 1934 (D).

*OSCILLATORIA* *TENUIS* Ag. ex Gom., Ann. Sci. nat. VII Bot. 16: 220, pl. vii, f. 2, 3 (1892); Hazen, RHODORA 26: 211 (1924); Croasdale, Fresh Water Alg. Woods Hole, Mass., 17 (1935). *O. limosa* of Wolle,



Fresh Water Alg. U. S. 313 (1887), in part, not Ag. ex Gom. *O. tenuis* var. *tergestina* of Croasdale, loc. cit. (1935). *O. brevis* of Croasdale, ibid. 18 (1935), not Kütz. ex Gom. Authentic material: Kütz. Dec. 34 (F); Rabenh. Alg. 50 (F), 1016 (F), 1599 (T).—Var. *NATANS* (Kütz.) Gom., ibid. 221, with trichomes 6–10  $\mu$  in diameter, and var. *TERGESTINA* (Kütz.) Rabenh. ex Gom., loc. cit., with trichomes 4–6  $\mu$  in diameter, are both abundantly represented in the freshwater collections. The two varieties are as a rule present in the same collections, but in variable proportions in different collections. The var. *natans* may sometimes be confused with *O. ornata*. Specimens seen: [?] EASTHAM: pond 10 miles south of Truro, E. T. Rose, 12 July 1936 (D, F, S, T, Y). FALMOUTH: in shallow water of Iron Pond, Woods Hole, Drouet 1939, 12 Sept. 1936 (D, N); floating on a pool across from Cedar Swamp, Woods Hole, Drouet 1940, 13 Sept. 1936 (D, F, N, S, T, Y); in a shallow pond by Quisset Avenue north of Golf Course, Woods Hole, Drouet 1906, 5 Aug. 1936 (D, N, S); Shank's Little Pond, Falmouth, H. Croasdale, 4 Aug. 1934 (D); subaerial on mud, Wood Pond, Woods Hole, Drouet 1918, 17 Aug. 1936 (D); muddy shore of Shiverick Pond, Falmouth, Drouet 1230, 8 Aug. 1934 (D); High Hat Pond, H. Croasdale, 31 July 1934 (D). GOSNOLD: Botanical Survey of Penikese Island, 24 July 1923 (W). FALL RIVER: Fall River (Wolle Collection, P).

*OSCILLATORIA CHLORINA* Kütz. ex Gom., Ann. Sci. nat. VII Bot. 16: 223 (1892); Croasdale, Fresh Water Alg. Woods Hole, Mass., 17 (1935).—Fig. 8 and 9. Occasionally seen in freshwater ponds. In drying, the trichomes become bright yellow in color. This color is not always produced, however, if the material is dried after a long period of preservation in formalin. See Geitler, Rabenh. Kryptogamen-Fl. 14: 952 (1932). Specimens seen: FALMOUTH: pond at dump on Gifford Street, Falmouth, H. Croasdale, 29 June 1934 (D, W); pond on Whitamore Estate, Woods Hole, H. Croasdale, 2 Aug. 1934 (D, F, S, T, Y); with *O. princeps* in a cranberry pond north of West Falmouth, E. T. Rose, 13 July 1936 (D).

*OSCILLATORIA AMPHIBIA* Ag. ex Gom., Ann. Sci. nat. VII Bot. 16: 221, pl. vii, f. 4, 5 (1892); Hazen, RHODORA 26: 211 (1924); Croasdale, Fresh Water Alg. Woods Hole, Mass., 17 (1935); not of Davis, Bull. U. S. Bur. Fish. 1911(2): 798 (1913). Authentic material: Kütz. Dec. 129 (F); Wittr. & Nordst., Alg. exs. 997 (F).—Mixed with other algae in fresh and brackish water. Specimens seen: GOSNOLD: Botanical Survey of Penikese Island, 24 July 1923 (W); Penikese Island, T. Hazen, 1923 (T); Pasque Island, H. Croasdale, 24 June 1930 (D); small pond on northeastern Pasque Island, Drouet 1873, 8 July 1936 (D, F, T, Y).

*OSCILLATORIA SPLENDIDA* Grev. ex Gom., Ann. Sci. nat. VII Bot. 16: 224, pl. vii, f. 7, 8 (1892); Hazen, RHODORA 26: 211 (1924); Croasdale, Fresh Water Alg. Woods Hole, Mass., 18 (1935). Authentic material: Wittr. & Nordst., Alg. exs. 784 (F); Rabenh. Alg. 161 (F),

329 (F); Hauck & Richt., *Phyk. univ.* 475 (F).—Common in the freshwater collections. Specimens seen: FALMOUTH: Fresh water, Woods Holl, *Trelease*, 1881 (F); in Shank's Little Pond, *H. Croasdale*, 12 Aug. 1934 (D, S); Oyster Pond, *H. Croasdale*, 12 Aug. 1931 (D, Y), *Drouet 1110*, 18 June 1934 (D, F, T); south shore, Nobska Pond, *E. T. Rose*, 18 June 1936 (D); in shallow water of Iron Pond, Woods Hole, *Drouet 1939*, 12 Sept. 1936 (D). GOSNOLD: Botanical Survey of Penikese Island, 24 July 1923 (W).

OSCILLATORIA GRANULATA Gardn., *Mem. New York Bot. Gard.* 7: 37, pl. 8, f. 71 (1927); descr. emend. *Drouet*, *RHODORA* 39: 278, f. 2 (1937).—Common in shallow freshwater and secondarily brackish pools along the seashore. I have already noted (loc. cit.) the geographic distribution of this species. Additional material from southern Massachusetts: FALMOUTH: in swampy area north of Nobska Point, *Drouet 2079*, 5 July 1937 (D, N, S). GOSNOLD: in bog above Tarpaulin Pond, Naushon Island, *Drouet 2126*, 12 Aug. 1937 (D, F, N, S).

OSCILLATORIA BREVIS Kütz. ex Gom., *Ann. Sci. nat. VII Bot.* 16: 229, pl. vii, f. 14 (1892); not of Croasdale, Fresh Water Alg. Woods Hole, Mass., 18 (1935). Authentic material: Rabenh. Alg. 30 (F, T).—Usually found on wet soil or in temporary pools of fresh water. Specimens seen: FALMOUTH: on wet soil in greenhouse at railroad station, Falmouth, *Drouet 1936*, 29 Aug. 1936 (D). FAIRHAVEN: on mud about a well and cow-trough by Highway 6 east of Fairhaven, *E. T. Rose & Drouet 1888*, 18 July 1936 (D, N, S).

OSCILLATORIA BREVIS var. NEAPOLITANA (Kütz.) Gom., *Ann. Sci. nat. VII Bot.* 16: 229, pl. vii, f. 15 (1892). *O. subuliformis* of Hazen, *RHODORA* 26: 215 (1924); of Croasdale, Fresh Water Alg. Woods Hole, Mass., 18 (1935); not Kütz. ex Gom. Authentic material: LeJolis, Alg. mar. Cherbourg 174 (F).—Frequent in brackish water, often mixed with other algae. Specimens seen: FALMOUTH: floating in a brackish pool south of Chara Pond, *Drouet 1921*, 18 Aug. 1936 (D, S); subaerial on mud, Gardiner's Ditch, Woods Hole, *Drouet 1197*, 22 July 1934 (D, T, W). GOSNOLD: Botanical Survey of Penikese Island, 24 July 1923 (W); Penikese Island, *T. Hazen*, 1923 (T).

OSCILLATORIA LUTEOLA *Drouet*, *RHODORA* 39: 277, f. 1 (1937). *Oscillatoria* sp. of Hazen, *RHODORA* 26: 215 (1924). Authentic material: Phyc. Bor.-Amer. 710 (W, T, Y), 1054 (W, T, Y).—Very common and abundant in quiet brackish water. Southern Massachusetts specimens in addition to those cited with the original description: FALMOUTH: floating on brackish water, Gardiner's Ditch, Woods Hole, *Drouet 2087*, 13 July 1937 (D); in brackish water of ditches about Mill Pond, Woods Hole, *Drouet 2179*, 2 Sept. 1937 (D, F, N, S).

OSCILLATORIA LAETEVIRENS *Crouan* ex Gom., *Ann. Sci. nat. VII Bot.* 16: 226, pl. vii, f. 11 (1892); not of Davis, *Bull. U. S. Bur. Fish* 1911(2): 798 (1913). *Phormidium persicinum* of Davis, *Phyc. Bor.-Amer.* 29: 1401 (1907), in part, not Gom.—On rocks and woodwork

between tide limits. Our material is very similar to that in a specimen collected by Crouan at Brest and obligingly transmitted to me by Prof. Frémy. Specimens seen: FALMOUTH: on rocks in spray of drain from Supply Department Building, Eel Pond, Woods Hole, *Drouet* 1904, 2 Aug. 1936 (D, F, N, S, T, Y); jar in Marine Biological Laboratory, *B. M. Davis*, May 1907 (Phyc. Bor. Amer. 1401, T; and in part, W, N, Y).

OSCILLATORIA FORMOSA Bory ex Gom., Ann. Sci. nat. VII Bot. 16: 230, pl. vii, f. 16 (1892); Croasdale, Fresh Water Alg. Woods Hole, Mass., 18 (1935). Authentic material: Moug. & Nestl., Stirp. crypt. vogeso-rhenanae 898 (F, N); Wittr. & Nordst., Alg. exs. 677 (F).—Not common in freshwater ponds. The two specimens are from the same locality: FALMOUTH: 'Desmid Haven' Pond, near West Falmouth, *H. Croasdale*, July 1935 (D), *C. M. Palmer*, 27 July 1936 (D).

SPIRULINA Turp. ex Gom., Ann. Sci. nat. VII Bot. 16: 249 (1892); emend. G. Schmidt apud Geitler, Beih. z. bot. Centralbl. II, 41: 283 (1925). *Arthrospira* Stizenb. ex Gom., ibid., 246 (1892).—It is doubtful, in light of the recent work on the morphology of the trichome in this group,<sup>17</sup> that distinct genera can still be retained for the septate and non-septate forms, as Geitler has repeatedly pointed out. In this paper I do not include treatment of *S. tenerrima* Kütz. ex Gom., which Gomont (ibid. 253) cites from the United States, and *S. Gomontiana* (Setch.) Geitl., reported by Hazen (as *Arthrospira Gomontiana* Setch.) in RHODORA 26: 215 (1924) from brackish water on Penikese Island; I have seen material of neither of these species from southern Massachusetts.

#### KEY TO SPECIES

- I. Spirals loose, i.e., not touching each other
  - A. Spiral irregular.—Trichomes 1.2–1.8  $\mu$  in diameter, the spirals 3.2–5  $\mu$  in diameter, 3–5  $\mu$  or more apart. . . . *S. Meneghiniana*
  - B. Spiral regular
    - 1. Trichomes pale blue-green, 1.2–1.7  $\mu$  in diameter, the spirals 2.5–4  $\mu$  in diameter, 2.7–6  $\mu$  apart. . . . . *S. major*
    - 2. Trichomes blue-green, 1.5–2  $\mu$  in diameter, the spirals 7.5–11.5  $\mu$  in diameter, 20–28  $\mu$  apart. . . . . *S. stagnicola*
- II. Spirals touching each other.—Plant-mass bright blue-green; trichomes pale blue-green, 1–2  $\mu$  in diameter, the spirals 3–5  $\mu$  in diameter, contiguous or here and there scarcely separated. . . . . *S. subsalsa*

SPIRULINA MENEGHINIANA Zanard. ex Gom., Ann. Sci. nat. VII Bot. 16: 250, pl. vii, f. 28 (1892). Authentic material: Rabenh. Alg. 895 (F), 1015 (F).—Apparently uncommon in brackish habitats and seen in only two specimens: FALMOUTH: 'occasional filaments of a fine loose Spirulina,' West Falmouth, *F. S. Collins*, 10 Aug. 1883 (N); West Falmouth, *F. S. Collins*, 10 Aug. 1883 (N).

<sup>17</sup> See list of major works in Crow, Trans. Amer. Microsc. Soc. 46: 139–148 (1927), and in Geitler, Rabenh. Kryptogamen-Fl. 14: 917 (1932).



*SPIRULINA MAJOR* Kütz. ex Gom., Ann. Sci. nat. VII Bot. **16**: 251, pl. vii, f. 29 (1892); Croasdale, Fresh Water Alg. Woods Hole, Mass., 18 (1935). *S. tenuissima* of Hazen, RHODORA **26**: 215 (1924); Croasdale, loc. cit. (1935); not Kütz. ex Gom. *S. densa* Lillick,<sup>18</sup> Amer. Midland Nat. **16**: 210, f. 1A (1935). Authentic material: Hauck & Richt., Phyk. univ. 38 (F); Rabenh. Alg. 250 (F).—Not commonly seen in the southern Massachusetts flora except among other algae in quiet brackish water. The species is widely distributed in inland freshwater habitats. Specimens seen: FALMOUTH: with other Myxophyceae floating in Gardiner's Ditch, Woods Hole, Drouet 1134, 30 June 1934 (D, F, T, Y); Penzance salt marsh, Woods Hole, E. T. Rose, 13 July 1936 (D); in ditch at east end of Mill Pond, Woods Hole, Drouet 2085, 9 July 1937 (D, N, S). GOSNOLD: Botanical Survey of Penikese Island, 24 July 1923 (W); Penikese Island, T. Hazen, 1923 (T).

*SPIRULINA STAGNICOLA* Drouet, Rhodora **39**: 279, f. 3 (1937).—One collection from brackish water: GOSNOLD: Nonamesset Island, E. T. Rose, 21 June 1936 (TYPE in Herb. F. Drouet; ISOTYPES: F, N, S, T, W, Y).

*SPIRULINA SUBSALSA* Oerst. ex Gom., Ann. Sci. nat. VII Bot. **16**: 253, pl. vii, f. 32 (1892); Collins, RHODORA **2**: 43 (1900); Tilden, Minn. Alg. **1**: 89 (1910); Davis, Bull. U. S. Bur. Fish. 1911(2): 798 (1913). *S. tenuissima* of Farlow, Mar. Alg. New Engl., 31 (1891); not of Hazen, RHODORA **26**: 215 (1924); not of Croasdale, Fresh Water Alg. Woods Hole, Mass., 18 (1935). *S. Thuretii* of Farlow, loc. cit. (1891). *Arthrospira subsalsa* Crow apud Croasdale<sup>19</sup> *pro synonym.*, Fresh Water Alg. Woods Hole, Mass., 18 (1935). Authentic material: Farl., Anders. & Eat., Alg. Am. Bor. Exs. 178 (F, Y); LeJolis, Alg. mar. Cherbourg 199 (F); Kütz. Dec. 14: 131 (T).—Often forming blue-green coatings on the bottom in shallow, quiet salt (rarely in brackish) water; more often mixed with other algae in salt marshes, on pilings of wharves, etc. Both f. *GENUINA* Gom. and f. *OCEANICA* (Crouan) Gom., *ibid.* 254, are distinguishable in the collections. Specimens seen: FALMOUTH: on algae attached near garbage wharf, Eel Pond, Woods Hole, C.-C. Jao, 20 July 1931 (D, S, W, Y); Woods Hole, I. Holden, 15 Aug. 1894 (F); Eel Pond, Woods Holl, W. G. Farlow,

<sup>18</sup> Miss Lois Lillick has obligingly allowed me to examine a slide of the original (TYPE) material of this species. Measurements of a considerable number of trichomes show that this material falls well within the dimensional range given by Gomont for the trichomes of *S. major*. I am unable to detect any morphological difference between the trichomes in this material of *S. densa* and those of the authentic material of *S. major* cited here. Another ISOTYPE of *S. densa* has been examined in the Herb. New York Bot. Gard.: INDIANA: floating in Lake St. Mary, Notre Dame University campus, Notre Dame, J. H. Hoskins 606, Aug. 1928.

<sup>19</sup> By a liberal interpretation of the present International Rules, we may accept this as the valid publication of the binomial *Arthrospira subsalsa*, even though not designated specifically as a new combination. Taxonomists may well be startled at the naive presentation of a classification of the species of *Spirulina* by Crow in Trans. Amer. Microsc. Soc. **46**: 142ff (1927).

Sept. 1881 (F); on dead algae in five feet of water, Wood's Holl, *W. G. Farlow*, Aug. 1876 (F); Eel Pond, Woods Hole, *Anon.*, 30 July 1908 (F); in water squeezed from *Vaucheria Thuretii*, Woods Hole, *W. T[release]*, 15 Sept. 1881 (F); Wood's Holl, Aug. 1876 (Y). GOSNOLD: Gosnold Pond, Cuttyhunk Island, *Anon.*, 28 July 1927 (W). OAK BLUFFS: in shallow water, Squash Meadow Pond, *G. Velasquez & Drouet 1896*, 21 July 1936 (D, F, T).

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#### EXPLANATION OF FIGURES

FIG. 1. *Schizothrix arenaria*, upper portion of filament from *Drouet 1217*. FIG. 2. *Hydrocoleum glutinosum*, from *Drouet 1917*, showing the apex of a single trichome with sheath. FIG. 3. *Hydrocoleum Holdenii*, the upper portion of a trichome with sheath drawn from the type specimen in the Farlow Herbarium. FIG. 4. *Lyngbya infixa*, an entire filament from *Drouet 1132*. FIG. 5. *Lyngbya Lagerheimii*, from *Drouet 1860*, the upper portion of a filament. FIG. 6. *Phormidium persicinum*, portion of a single trichome from Phyc. Bor.-Amer. 1401 (W). FIG. 7. *Phormidium molle*, portion of a single trichome from a specimen collected by F. S. Collins at Bourne. FIG. 8 AND 9. *Oscillatoria chlorina*, upper portions of two trichomes from West Falmouth, collected by E. T. Rose.—All these figures have a magnification of  $\times 800$  and, with the exception of Fig. 3, 6, and 7, are drawn from living material.

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## NOTES ON THE FLORA OF NOVA SCOTIA

A. E. ROLAND

IN early September 1936, I spent several days upon Long Island, Digby County. Time was taken to visit the Bay of Fundy seashore; and a number of plants were collected along the low banks of a sheltered cove. A *Cornus*, new to me, covered the exposed sides of the banks. I am indebted to Frère Marie Victorin of the University of Montreal for identifying it for me as *Cornus canadensis*, var. *intermedia*.

The following morning, barely enough time was spent upon Brier Island to cross it and return. At the further side by the lighthouse is a meadow many acres in extent, and protected from the waves of the Bay of Fundy only by a low line of rocky ledges. Ten minutes only were spent upon this meadow or bog; but they were sufficient to collect a number of sheets of *Schizaea*, which was found wherever it was looked for; and to secure some individuals of the *Lophiola* which was growing scattered over the area.

The following are some of the plants collected in this region; and

others that may be of interest from different parts of the province. Specimens are in the herbarium of the Nova Scotia Agricultural College, Truro; or at Acadia University, Wolfville, N. S.

*SCHIZAEA PUSILLA* Pursh. DIGBY COUNTY: behind the sea wall, south end of Brier Island. Probably common over many acres.

*JUNIPERUS HORIZONTALIS* Moench. DIGBY COUNTY: grassy roadside above Westport, Brier Island. Previously known from headlands, further up the Bay of Fundy.

*SPOROBOLUS UNIFLORUS* (Muhl.) Scribn. Common in southwestern Nova Scotia and now known from Kings and Halifax Counties. DIGBY COUNTY: common in pastures and bogs, Central Grove. KINGS COUNTY: low places in barrens, Auburn. HALIFAX COUNTY: damp hollows, slaty upper beach of (Shubenacadie) Grand Lake.

*LILIUM CANADENSE* L. Previously known from near Truro to Cape Breton. Probably general from Windsor to Truro. HANTS COUNTY: river alluvium along St. Croix River near Windsor.

*LOPHIOLA AMERICANA* (Pursh) Wood. DIGBY COUNTY: scattered in a meadow by the lighthouse, southern end of Brier Island. The third station in Nova Scotia.

*IRIS SETOSA* Pall., var. *CANADENSIS* Foster. DIGBY COUNTY: headlands of Bay of Fundy, Central Grove.

*PYRUS ARBUTIFOLIA* (L.) L. f. KINGS COUNTY: border of Lily Pond, Centreville, Sept. 5th. With the berries small and still bright red in color. Previously known from Yarmouth and Shelburne Counties.

*AMELANCHIER FERNALDII* Wiegand. GUYSBOROUGH COUNTY: growing about two feet high in a high bog near Larry's River. Previously reported in Nova Scotia only from St. Paul's Island.

*HELIANTHEMUM CANADENSE* (L.) Michx. KINGS COUNTY: common upon the sandy plains at Auburn.

*CORNUS CANADENSIS* L., var. *INTERMEDIA* Farr. DIGBY COUNTY: headlands of the Bay of Fundy, Central Grove.

*HALENIA DEFLEXA* (Sm.) Griseb. GUYSBOROUGH COUNTY: wet meadow, near Sherbrooke.

Although this species is listed by Nichols and by Perry from Northern Cape Breton Island, this is apparently the first record of it from the mainland of Nova Scotia.

*CYNOGLOSSUM BOREALE* Fernald. HANTS COUNTY: on the gypsum outcrops between Windsor and Brooklyn.

*IVA ORARIA* Bartlett. KINGS COUNTY: on the brackish soil by the covered bridge, Hortonville.

NOVA SCOTIA AGRICULTURAL COLLEGE,  
Truro, Nova Scotia.



# NOTES FROM THE UNIVERSITY OF MINNESOTA HERBARIUM—I<sup>1</sup>

JOHN B. MOYLE

## EXTENSIONS OF RANGES AND ADDITIONS TO THE MINNESOTA FLORA

ECHINOCHLOA WALTERI (Pursh) Nash. Not recorded in the manuals as occurring in Minnesota. WASECA Co.: shores of Lake Waseca, *Aiton* Aug. 1890. LAC QUI PARLE Co.: in 1 foot of water, west end of Lac qui Parle, *Moyle* 3005.

BROMUS ARVENSIS L. CLEARWATER Co.: dry, open soil on campus of the University of Minnesota Forestry School, Itasca State Park, *Moyle* 2738.

B. TECTORUM L. HUBBARD Co.: dry roadsides near Arago Post Office, *Moyle* 472. PIPESTONE Co.: Pipestone, *Fellows* 3.

ELEOCHARIS OLIVACEA Torr. Two collections from the north-central part of the state. TODD Co.: Philbrook, *Hotchkiss & Jones* 4136. CLEARWATER Co.: mucky shore of Mink Lake, Itasca State Park, *Moyle* 931.

E. OVATA (Roth) R. & S., var. HEUSERI (Uechtritz) Garcke. Collected only from the Anoka outwash plain. ANOKA Co.: Peaty margin of small pond near Coon Lake, *Cooper* Oct. 12, 1930; Carlos Avery Game Refuge, *Moyle & Webb* 2683.

SCIRPUS CLINTONII Gray. RAMSEY Co.: in acid peat meadows along the road to New Brighton, *Rosendahl* 6174. STEARNS Co.: St. Cloud, *Campbell* 86. HENNEPIN Co.: Minneapolis, *Sandberg* June 1894. CLEARWATER Co.: dry norway pine forest, Itasca State Park, *Moyle* 2030.

S. PALUDOSUS A. Nels. Occurs quite commonly along the margins of the more or less alkaline prairie-lakes of southwestern Minnesota. OTTERTAIL Co.: Fergus Falls, *Ballard* 2539, 2544. PIPESTONE Co.: Pipestone, *Fellows* 54. YELLOW MEDICINE Co.: shallow lake bed 4 miles north of Hendricks, *Kreuholz* 3. TRAVERSE Co.: marshy shores of Lake Traverse, *Butters, Johnson & Rosendahl* 4056. KANDIYOH Co.: Willmar, *Frost* 264. LYON Co.: Dennin Slough, *Hotchkiss & Jones* 3982, 3987. BIG STONE Co.: sandy margin of island in Big Stone Lake, *Moyle* 2317.

CHENOPODIUM BOSCIANUM Moq. Fairly common in wooded places in southern Minnesota, but little collected. HENNEPIN Co.: Meeker Island, *Sheldon* Sept. 1894. MURRAY Co.: common in oak forest on the shores of Lake Shetek, *Moyle* 2993.

CARDAMINE PRATENSIS L. Reported as occurring in the state by both Lapham<sup>2</sup> and Upham<sup>3</sup> but neither reported nor collected since.

<sup>1</sup> Specimens cited are all in the Univ. of Minn. Herbarium. All specimens of a given species or variety are cited. The counties mentioned are all in Minnesota.

<sup>2</sup> Lapham, Catalogue of the Plants of Minnesota, Milwaukee 1865. Published in the report of the Minn. State Hort. Soc. 1875.

<sup>3</sup> Upham, Catalogue of the Flora of Minnesota; Geol. and Nat. Hist. Surv. of Minn. Part VI of the Ann. Rep. for 1883.

CLEARWATER CO.: Mossy tamarack bog, Itasca State Park, *Moyle* 2153.

DIPLOTAXIS MURALIS DC. Formerly known only from the southwest corner of the state. PIPESTONE CO.: along railroad yards, Pipestone, *Rosendahl* 4909. Collected in the summer of 1936 in the northern part of the state. BELTRAMI CO.: abundant for miles along the road north of Washkish, *Rosendahl & Moyle* 2190.

RUBUS ACAULIS Michx. Occurs in the muskegs near the Canadian border. LAKE OF THE WOODS CO.: near Baudette, Fadness 1928. This specimen, which was mailed in for determination, was accompanied by the statement "it grows in great profusion on our farm." In the summer of 1936, numerous large patches were found growing in a drained muskeg 8 miles south of Baudette, *Rosendahl & Moyle* 2180.

STROPHOSTYLES HELVEOLA (L.) Britton. Abundant in the southeastern portion of the state but uncommon westward. HOUSTON CO.: Jefferson, *Lyon* 387. WABASHA CO.: shore of Lake Pepin, *Manning*, Aug. 20, 1892; Lake city, *Manning* Aug. 8, 1897. GOODHUE CO.: July 1884, Aug. 1885. HENNEPIN CO.: Minneapolis, *Ramaley* Aug. 1894. SCOTT CO.: west of Savage, along railroad embankment, *Rosendahl* 4229. BLUE EARTH CO.: *J. B. L.* no date. WATONWAN CO.: Madelia, *C. A. S.* Aug. 20, 1889. LAC QUI PARLE CO.: growing in crevices in schistose rocks on an island in Lac qui Parle, *Moyle* 2304. This last collection represents a considerable westward extension of range.

EUPHORBIA PETALOIDEA Engelm. A plains species that has been twice collected in the western part of the state. OTTERTAIL CO.: Clitherall, *Campbell* July 1887; again in 1936 within a few miles of this location; sandy beach of Ottertail Lake, *Moyle* 2333.

CORNUS SUECICA L. This arctic species seems not to be recorded as occurring in the United States. ST. LOUIS CO.: fairly abundant in a perched black spruce bog on a high and heavily glaciated ridge near Ely, *Moyle* 2394; also observed in a spruce and white cedar bog near Low Lake in the same region.

CUSCUTA CUSPIDATA Engelm. Range cited in Gray's Man. edit. 7 as "Neb. to Mo. and Tex." LAC QUI PARLE CO.: shore of Lac qui Parle on *Salix amygdaloides* and *Solidago*, *Moyle* 2295.

SALVIA LANCEOLATA Willd. WINONA CO.: Winona, annotated "escaped," *Holzinger*, no date; *Holzinger* July 10, 1888. LAC QUI PARLE CO.: roadside near west end of Lac qui Parle, *Moyle* 3001.

PLANTAGO ARENARIA W. & K. HENNEPIN CO.: Mississippi River flats near Ford Dam, Minneapolis, *Moyle & Remmele* Oct. 9, 1932; *Cooper* Oct. 26, 1934; *Moyle* 3121. OTTERTAIL CO.: dry, gravelly beaches of Lake Pelican, *Stevens* July 16, 1933.

UNIVERSITY OF MINNESOTA.

TUCKERMAN TO CAREY.—The following letter, sent by Dr. C. G. ALM, Keeper of the Linnéträdgården at Upsala, is well worth publicly reproducing.—EDS.

Cambridge 1 Oct. 1845.

Dear Sir

Permit me to express to you the sorrow, which, in common with every American Botanist, I felt, at your affliction, and your irreparable losses. Your kind letter has given me the opportunity to offer you the sympathy even of one so little known to you as myself. What Botanist could be silent? But alas how little will words avail in such a case. We can only bow to the Supreme.

I trust you may yet have many years of delightful toil, in restoring your invaluable American Herbarium—in building it anew. I am always glad when my stock of a rare plant within the circuit of my herborising is exhausted, for the pleasure of making a new stock—and yet better samples. For myself I am ready to offer to supply you within 2 or 3 years at the furthest (my present avocations place me some miles from my Herb<sup>m</sup>, and I have no time to renew my dupl.) with a set of alpine & other N. E. Carices as also with a large set of foreign ones including the rare Scandinavian species. Your other corresp<sup>s</sup> must all renew their specimens—and so ere many years may not your Herb<sup>m</sup> arise Phoenix-like, restored? I can also, & will most gladly, offer you other plants—the moment I am free to devote myself wholly to Botany. I cannot forbear mentioning here that in the Great Hamburg fire Dr. Buek, the botanist, lost his whole Herb<sup>m</sup>. The very last occupation in which I saw the illustrious Robert Brown employed was in putting up a box of his duplicates to send to the Hamburg naturalist. The memory of this must be my excuse, if I have erred in making the offer above. Did however any Botanist feel differently—I should think little of him indeed.

Permit me also to send with this another copy of my Carices, and another little book, both of which publ. being published for gratuitous circulation.

I am always most happy to have the opportunity of offering them to Botanists.

With great respect  
I am yours humb. Serv<sup>t</sup>  
Edw. Tuckerman

John Carey Esq.  
Greenwich st. N. Y.



CHROMOSOMES OF KALMIOPSIS.—Henderson<sup>1</sup> described an ericaceous shrub of restricted range in the Siskiyou Mountains of Oregon under the name *Rhododendron Leachianum*, a species close, in his opinion, to *R. lapponicum*. Rehder<sup>2</sup> established the monotypic genus *Kalmiopsis*, taxonomically near *Loiseleuria*, *Kalmia*, and *Rhododendron*, and made the combination *Kalmiopsis Leachiana* (Henderson) Rehder.

*Kalmiopsis Leachiana* (grown at Cornell University by W. C. Wilson; herbarium specimen in the Bailey Hortorium) has 24 somatic chromosomes (FIG. 1); each of the chromosomes has a median or submedian constriction.



Hagerup<sup>3</sup> determined the  $n$ -number of *Rhododendron lapponicum* to be 13. Sax<sup>4</sup> found  $n$ -numbers of 13 and 26 in *Rhododendron* and concluded that 13 is its fundamental number. Nakamura<sup>5</sup> made similar observations for the genus. Bowers<sup>6</sup> counted 12 gametic

<sup>1</sup> Henderson, L. F. New Plants from Oregon. *RHODORA* 34: 203–206. 1931.

<sup>2</sup> Rehder, Alfred. *Kalmiopsis*, a New Genus of Ericaceae from Northwest America. *J. Arnold Arboretum* 13: 30–34. 1932.

<sup>3</sup> Hagerup, O. Morphological and Cytological Studies of Bicornes. *Dansk Bot. Arkiv*, 6: 1–26. 1928.

<sup>4</sup> Sax, Karl. Chromosome Stability in the Genus *Rhododendron*. *Amer. J. Bot.* 17: 247–251. 1930.

<sup>5</sup> Nakamura, M. Cytological Studies on the Genus *Rhododendron*. *J. Soc. Trop. Agriculture* 3: 103–108. 1931.

<sup>6</sup> Bowers, C. G. The Development of Pollen and Viscin Strands in *Rhododendron catawbiense*. *Bull. Torrey Bot. Club* 57: 285–314. 1930.

chromosomes in *Rhododendron*, but Sax investigated the same species and found them to fit into a 13-system. The single species of *Loiseleuria* and the two karyologically known species of *Kalmia* belong, like *Kalmiopsis*, to a 12-chromosome system: *Loiseleuria procumbens*,  $n = 12$ ; *Kalmia latifolia*,  $n = 12$ , and *Kalmia glauca*,  $n = 24$  (Hagerup). These chromosome numbers, therefore, afford an additional basis for the generic segregation of *Kalmiopsis* and support Rehder's views concerning the affinities of the genus.—J. T. BALDWIN, JR., Bailey Hortorium and Department of Botany, Cornell University.

## PLANTS NEW TO MINNESOTA

### OLGA LAKELA

Eight species new to Minnesota have been collected by the writer in the environs of Duluth during the past two seasons. One of these, *Poa Chairii* Vill. is new to America.<sup>1</sup>

*AMMOPHILA BREVILIGULATA* Fernald grows abundantly on the sandy beach of Lake Superior on Minnesota Point. It occurs commonly on the sandy south shore of the lake. With reference to the species, Warren Upham in the Catalogue of the Flora of Minnesota concludes with supposition, "doubtless also on the shore of this lake in Minnesota." It has not been found on the north shore of Lake Superior which is a shingle beach. The specimens, 1316 and 1613 from Minnesota Point are the first collections made in the state.

*DESCHAMPSIA FLEXUOSA* (L.) Trin. occurs on Minnesota Point. The dense, vigorously growing tufts of this grass are fairly numerous, but scattered along the main trail through a distance of about one-eighth of a mile. The recorded range of this species includes Wisconsin. Warren Upham supposed its occurrence in Minnesota. The specimens 2069, 2102 and 2106 were collected from a colony growing in moist soil under pine trees, near a small bog, in Sec. 19.

*ARTEMISIA STELLERIANA* Bess. A single poorly growing clump in wet sand of the Superior Bay shore in Sec. 13, in the narrowest part of Minnesota Point, locally known as the "Barrens." Specimen 2121 was the only stem in flower among the few sterile ones in 1937. During the preceding year the plant did not bloom. In a few other places on the bay front farther north, sterile stems have been noted. Evidently the habitat is not congenial to this eastern Asiatic species.

*IRIS PSEUDACORUS* L. Several plants grow at the "Barrens" on Minnesota Point, along the margin of a small, wet meadow overgrown with sedges and rushes of several species. Specimens 1466a, 1466b and 1504 were collected in 1936. In 1937 one plant was noted

<sup>1</sup> Lakela, Olga. *The Occurrence of Poa Chairii in America*, RHODORA, xl. 73 (1937).

in flower on Oatka Beach Addition, about one mile north of the "Barrens." The plant appeared in the second year vegetation in this habitat, among *Bidens* in shallow water of the bay shore.

*STELLARIA AQUATICA* (L.) Scop. grows abundantly along several streams in East Duluth. The specimens, October 15, 1936, were collected in Congdon Park, between Fourth and Superior Streets, 32nd. Ave. east. The plants grow in broken rock of the stream bed, and in crevices of gabbro near the water level. The leaves in vigorously growing plants are variegated, streaked with white.

*POTENTILLA GRACILIS* Dougl. was found on the north-facing slope of Hunter's Hill, in grassy turf covering rocks in an old stream bed. Grasses dominate the ground vegetation in the open places; higher on the slope grow thickets of several species of shrubs and young oak trees. The specimens 2088a were collected on July 20, 1937; it appears to be the typical form.

*POLEMONIUM OCCIDENTALE* Greene. Several vigorously growing plants were found along a small stream in a mixed forest on the north-east-facing slope of Hunter's Hill, among *Laportea canadensis* and *Pterotis nodulosa*. It may be a garden escape. However, inquiries in the nearby residences and the Greenhouse resulted without information regarding the species. The specimens were collected on July 11, 1937.

The writer wishes to extend thanks to Dr. John W. Moore, University of Minnesota, who made the final check in the manuscript, of the synonymy and the determinations of the species.

STATE TEACHERS COLLEGE,  
Duluth, Minnesota.

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